Joe G.
37
Acc.

MCDONNELL AIRCRAFT COMPANY

Saint Louis, Missouri 63166

28 February 1986

RECEIVED

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PRMT SECTION

Mr. Joe Galbraith, Environmental Engineer
Environmental Protection Agency, Region VII
Waste Management Section
726 Minnesota Avenue
Kansas City, KS 66101

Subject: Submittal of Reactive Waste (Explosive) Thermal Treatment Report

References: (a) United States Environmental Protection Agency, Region VII Permit Number MOP000000204, dtd 23 August 1985

(b) Teleconference dtd 20 December 1985 - Representatives: Missouri Department of Natural Resources - J.D. Doyle; MCAIR - H.D. Rehkop, G.B. Saunders

Enclosures: (1) McDonnell Aircraft Company - Summary of Reactive Waste (Explosive) Thermal Treatment

(2) GSX Services, Inc's Soil and Air Sample Report

(3) McDonnell Aircraft Company - Gases Produced as a Result of Reactive Waste (Explosive) Thermal Treatment

Dear Mr. Galbraith:

In compliance with References (a) and (b), Enclosures (1), (2), and (3) are respectively submitted.

If after your review should additional data be required, please advise.

Bob Kaatman

R.H. Kaatman, Supervisor
Environmental Compliance
Sta (314) 232-3319

Concur: H.D. Rehkop

H.D. Rehkop, Branch Manager
Hazardous Materials Control
Sta (314) 234-7716

RHK:tb

EC: Tom Pauling, Mo DNR
Glen Estes, NAVPRO - STL
J.G. Smith, GSX Services, Inc.

MCDONNELL DOUGLAS CORPORATION

MCDONNELL AIRCRAFT COMPANY

SUMMARY OF REACTIVE WASTE (EXPLOSIVES) THERMAL TREATMENT ACTIVITIES

Jul 80 - 13 Dec 85 McDonnell Aircraft Company (MCAIR) accumulates GFAE and CFE Reactive Waste (Explosive) due to the fact that no legal OFF-SITE Disposal Facility can be located for the disposal of material. The explosive waste as it accumulated was packaged in accordance with Department of Transportation Regulations - Code of Federal Regulations (CFR) Titles 40 and 49. These packages were then placed in MCAIR's state permitted Reactive Waste Storage Facility, Building 10.

Dec 83 - 02 Jan 86 GSX Services, Inc., (GSX) Reidsville, NC a disposal contractor of Reactive Waste was issued a Purchase Order by MCAIR for the thermal treatment of Reactive Waste.

Apr 85 - 09 Jan 86 MCAIR pursued and obtained the appropriate emergency directive permits for thermal treatment of the waste from the United States Environmental Protection Agency Region VII Kansas City, KS and the Missouri Department of Natural Resources (Mo DNR). Two (2) permits were required from the Mo DNR, a Burn and a Transportation/Temporary Storage/Treatment Permit.

16-17 Dec 85 In accordance with the federal and state emergency directive permits the following activities were performed prior to movement of materials to the treatment site - Bigspring Quarry in Bigspring, Mo.

- o 16 Dec 85 GSX personnel with disposal equipment arrived at treatment site and prepared the quarry for the thermal treatment effort.
- o 16 Dec 85 MCAIR notified Mo DNR St. Louis Office that movement of Reactive Waste would commence on 18 Dec 85.
- o 17 Dec 85 MCAIR provided notification of Reactive Waste movement from MCAIR Bldg 10 commencing on 18 Dec 85 to the following authorities:
  - o Mo Highway Department Troop C (Mo Highway Department Troop C provided notification to local police departments along the route, for the movement on 18 Dec 85).
  - o St. Louis County Police.
  - o Montgomery County Sheriff's Department.
  - o Hermann, Mo Fire Department.
  - o Bigspring Volunteer Fire Department.

Encl (1) to
R.H. Kaatman ltr
dtd 28 Feb 86

MCDONNELL AIRCRAFT COMPANY

SUMMARY OF REACTIVE WASTE (EXPLOSIVES) THERMAL TREATMENT ACTIVITIES

18 Dec 85	GSX's transportation vehicles arrived at MCAIR Bldg 10 for pick-up of Reactive Waste. Materials were loaded and ready for transportation when MCAIR received telecon from Mo DNR putting a hold order on the movement. In order to resolve the hold order of the Reactive Waste; representatives from Mo DNR, GSX and MCAIR convened at Bigspring Quarry to discuss the disposal activities with two (2) local residents. MCAIR and GSX representatives provided a briefing to the local residents about the thermal treatment project. The local residents were satisfied with the response they received and shortly after the briefing left the treatment site. The hold order, however, was still in effect because only the Director of Mo DNR could remove the hold order. The earliest the hold order could be lifted would be on the morning of 19 Dec when the Director and his staff would hold their special staff meeting. Note: Notification was provided to the appropriate authorities that the transport of explosives was on hold with pending transport on 19 Dec 85.
19 Dec 85	MCAIR, via telecon, received verbal approval from Mo DNR to transport the Reactive Waste. Notification was provided to appropriate authorities that MCAIR had Mo DNR approval to transport the Reactive Waste. GSX's trucks were inspected, Waste Manifest signed, and vehicles were released for transport. In the afternoon of the 19th, GSX's vehicles arrived at treatment site and all of the Class A Explosives were detonated. Mo DNR notified GSX personnel that all disposal operations were on hold until additional air monitoring equipment could be implemented at the treatment site.
20 Dec 85	Mo DNR, GSX and MCAIR representatives resolved the additional air monitoring equipment problem via telecon. Shell Engineering and Associates, Inc. of Columbia, Mo were subcontracted by GSX to provide the reagents and testing equipment in order to satisfy the air monitoring requirements. Problems arose as to availability of the reagents, the earliest that Shell Engineering could possibly be at the treatment site was the 23rd or 24th of December. Due to the delay in the thermal treatment process, GSX made the decision that all thermal treatment operations be suspended for the Christmas Holidays until 30 Dec 85. GSX via agreement with MCAIR hired bonded guards to protect the explosives over the holidays. Local fire departments were notified that the thermal treatment of explosives had been suspended until 30 Dec 85.

MCDONNELL AIRCRAFT COMPANY

SUMMARY OF REACTIVE WASTE (EXPLOSIVES) THERMAL TREATMENT ACTIVITIES

30 Dec 85	Hermann and Bigspring Fire Department were notified that with Mo DNR's approval the thermal treatment of Reactive Waste would commence again at 8:00a.m. At 8:30a.m. Mo DNR, GSX, Shell Engineering and MCAIR representative(s) convened at the Bigspring Quarry Treatment Site. Mo DNR representative concurred with the course of action/position of testing equipment for air monitoring samples and gave approval for the resumption of the thermal treatment of the Reactive Waste. GSX personnel resumed thermal treatment operations. Waste explosives treated on Monday included 25mm Ammunition, 20mm Ammunition, and Rocket Motors. Shell Engineering performed air monitoring sampling as required.
31 Dec 85	Treatment of Explosive Waste continued. Treated explosives included 20mm Ammunition other Class C Explosive items, and Rocket Motors. Throughout the day Shell Engineering continued to perform air monitoring sampling as required. Late in the afternoon Shell Engineering representative conferred with Mo DNR and a concensus was reached that enough air monitoring samples had been conducted and no further air samples would be required.
01 Jan 86	Thermal Treatment operations of Reactive Waste continued with the burning of 20mm Ammunition and other Class C Explosives.
02 Jan 86	The final day of treatment commenced with the disposal of Rocket Motors, 20mm Ammunition, other Class C Explosives and the Trimethylaluminum Cylinder. After thermal treatment was completed by GSX personnel, the area was policed picking up all residue materials as a result of treatment operations. Hermann/Bigspring Fire Departments and Mo DNR were notified that all thermal treatment of Reactive Waste was completed with no incidences to report. MCAIR was unsuccessful in notification to federal authorities on completion of thermal treatment as project personnel were out of the office till 06 Jan. GSX loaded up their equipment and departed for Reidsville, NC.
06 Jan 86	Notified United States Environmental Protection Agency Region VII Kansas City, KS that all thermal treatment of Reactive Waste had been completed with no incidences to report.

GSX

GSX Services, Inc.
Emergency, Remedial &
Technical Projects Group
P.O. Box 210
Reidsville, North Carolina 27320
(919) 342-6106
(919) 272-2222 (Emergency Response)

February 21, 1986

Mr. George Saunders
McDonnell Aircraft Company
P.O. Box 516
Saint Louis, Missouri 63166

Dear Mr. Saunders:

Enclosed please find analysis for air and soil samples collected during GSX Services, Inc's. (GSX) treatment of McDonnell Aircraft Company munitions during December 1985 and January 1986. Air samples were analyzed by Shell Engineering and soil samples by General Engineering Laboratories. The soil sample was a composite of soil from the site and the burn boxes after treatment.

If you have any questions, or if there is additional information that you require, please contact me at 919-342-6106.

Sincerely,

Jackie G. Smith

Jackie G. Smith
Senior Project Manager
ERT Projects Group

cc: Mark Johnson
Danny Stubbs

Encl (2) to
R.H. Kaatman ltr
dtd 28 Feb 86

Engineering Consulting
Chemical Analysis

GENERAL ENGINEERING LABORATORIES
1313 Ashley River Road
Charleston, S.C. 29407
P.O. Box 30712
Charleston, S.C. 29417
Phone (803) 556-8171

Client	GSX Corporation PO Box 210 Watlington Industrial Park Reidsville, N.C. 27320	**Date**	February 13, 1986
		P.O. No.	
		Requested by	Mr. Mike Edwards

CERTIFICATE OF ANALYSIS

Laboratory Certification Number 10120

Demolition Bcf

Sample Type: Solid - Level III Analysis - Demolition Series
Date Received: February 3, 1986
Collected/Delivered By: GSX Corporation

Parameter	Results*
Sample I.D.	
Lab No	86019238
Flash Point, ^{o}F	>140
Reactivity	
With Air	N
With Water	N
With Acid	N
With Base	N
Release of Cyanide Gas	N
Release of Hygrogen Sulfide Gas	N
Oxidizer	N
Reducer	N
Phenols, ug/kg	<20
Solids, Wt%	0.463
Acid Phthalate, mg/kg	3.8
Nitrates, mg/kg	<1.0

*S = Strong
M = Moderate
N = Negligible

Respectfully Submitted By George C. Greene /WBG
George C. Greene, P.E., Ph.D.

fc: gsxrl.G2

AMBIENT AIR MONITORING

DURING THE ORDNANCE DESTRUCTION

AT BIG SPRING, MISSOURI

February 11, 1986

shell engineering and associates, inc.

columbia, missouri

shell engineering and associates, inc.

staircase offices parkade plaza p.o. box 548 columbia, mo 65205 E-296
314-875-2166

February 11, 1986

Mr. Jackie Smith
GSX Services
Watlington Industrial Road
P.O. Box 210
Reidsville, NC 27320

Dear Mr. Smith:

Shell Engineering & Associates, Inc., respectfully submits this report entitled "Ambient Air Monitoring During the Ordnance Destruction at Big Spring, Missouri." The report discussed the ambient air monitoring program carried out by Shell Engineering on December 30 and 31, 1985. This monitoring was conducted in cooperation with requirements of the Waste Management Program of the Missouri Department of Natural Resources (MDNR).

The monitoring did not reveal significant levels for most of the elements sampled. However, some measurable levels of chlorine, hydrochloric acid and lead were collected. Those levels are discussed in the sampling results section of the report.

Shell Engineering greatly appreciates this opportunity to be of service and would appreciate your consideration in the future.

If you have any questions, please do not hesitate to call.

Very truly yours,

SHELL ENGINEERING & ASSOCIATES, INC.

Billy F. Keeling

Billy F. Keeling, P.E.
Senior Engineer

BFK/skk
Attachment
cc: George Saunders

TABLE OF CONTENTS

I. INTRODUCTION

GSX Services retained Shell Engineering & Associates, Inc., to conduct ambient air sampling during the planned destruction of surplus ordnance from the McDonnell Douglas Corporation. The sampling was done at the request of the Missouri Department of Natural Resources (MDNR) and was conducted on December 30 and 31, 1985. The location was in an inactive quarry pit at the Big Spring Quarry outside of Big Spring, Missouri. The ambient air was sampled for the presence of 7 different chemicals and 31 different minerals. Shell Engineering collected the samples and the analyses were conducted by Ctek Environmental Health Laboratory, Dallas, Texas, and the University of Missouri Environmental Trace Substance Research Center (ETSRC), Columbia, Missouri.

The sampling procedures were changed slightly from the original proposal in that the detonations were more severe than had been anticipated. Mr. Pauling of the Missouri DNR Waste Management Program approved the changes; namely, locating the samplers at a greater distance from the dumpsters than had been planned.

The leading representatives present during the project are listed below.

Mr. Jackie Smith	GSX Services
Mr. Billy F. Keeling	Shell Engineering & Associates, Inc.
Mr. Harold Rehkop	McDonnell Douglas Corporation
Mr. Thomas Pauling	Missouri DNR Waste Management
Mr. Terry Wehling	McDonnell Douglas Corporation

The weather conditions were clear and cold with gusty winds from the Northwest.

II. SAMPLING METHODS AND PROCEDURES

The sampling was accomplished by collecting samples during the periods for which the ordnance was being destroyed. All the samples were taken by pulling air through collecting mediums at calibrated and specific flow rates. Table I summarizes the pollutants sampled, type of pump used, pump flow rate, and the time sampled.

The phosphorus pentachloride and trichloride, phosgene, and chlorine were collected using midget bubbler impingers and absorbing reagents. The reagents were prepared by Ctek Laboratories. The HCL and Phosphoric Acid were collected in Orbo tubes. The lead, tin oxide,

TABLE I
SAMPLING RESULTS

Pollutant Sampled	Run #	Pump Type	Flow Rate (cc/min.)	Sample Time (sec.)	Mass Collected (m^3)	Concentration (ug/m^3)
Phosphorus	2	SKC#1	168	495	<5.1	<3680
Pentachloride	4	SKC#1	168	1,200	<5.1	<1518
Pentachloride	5	SKC#1	168	3,600	<5.1	< 506
Phosphorus	2	SKC#1	168	495	<6.7	<4835
Trichloride	4	SKC#1	168	1,200	<6.7	<1994
Trichloride	5	SKC#1	168	3,600	<6.7	< 665
Phosgene	2	RM001	1,000	375	<0.1	< 16
Phosgene	4	SKC#2	1,000	1,200	<0.1	< 5
Phosgene	5	SKC#2	1,000	3,600	<0.1	< 2
Chlorine	2	RM001	1,000	375	0.34	< 54.4
Chlorine	4	SKC#2	1,000	1,200	0.23	< 11.5
Chlorine	5	SKC#2	1,000	3,600	0.66	< 13.2
Lead	2	AID	1,758	507	<3.1	< 209
Lead	4	AID	1,758	1,200	<3.1	< 88.2
Lead	5	AID	1,758	3,600	12.0	170.6
Tin Oxide	2	AID	1,758	507	<11.0	< 742
Tin Oxide	4	AID	1,758	1,200	<11.0	< 313.3
Tin Oxide	5	AID	1,758	3,600	<11.0	< 104.4
Zinc Oxide	2	AID	1,758	507	< 1.2	< 34.2
Zinc Oxide	4	AID	1,758	1,200	< 1.2	< 14.5
Zinc Oxide	5	AID	1,758	3,600	< 1.2	< 4.8
HCL	2	RM002	500	375	23.0	7,360
HCL	4 up	SKC#2	1,000	1,200	30.0	1,500
HCL	4 dn	SKC#2	1,000	1,200	46.0	2,300
HCL	5	RM002	500	3,600	35.0	1,167
Phosphoric Acid	2	RM002	500	375	< 3.0	< 960
Phosphoric Acid	4	SKC#2	1,000	1,200	< 3.0	< 150
Phosphoric Acid	4	SKC#2	1,000	1,200	< 3.0	< 150
Phosphoric Acid	5	RM002	500	3,600	< 3.0	< 100

TABLE I (Con't)
SAMPLING RESULTS

Pollutant Sampled	Run #	Pump Type	Flow Rate (cc/min.)	Sample Time (sec.)	Mass Collected (m^3)	Concentration (ug/m^3)
Phosphorus	2	SKC#2	221	495	< 0.0015	< 0.82
Phosphorus	4	SKC#1	168	1,200	< 0.0015	< 0.45
Phosphorus	5	SKC#1	168	3,600	< 0.0015	< 0.15

and zinc oxide were collected on low-volume filter cassettes. Hi-volume air samplers were also run to collect larger volumes or particulates for mineral analyses by the ICP method at ETSRC.

The monitoring was done as close as possible to the dumpsters in which the burning was done. Figures 1, 2, and 3 give a sketch of the quarry arrangements for each sampling period during the monitoring program. The chemical samplers and hi-vol placements are indicated on each figure. Figure 1 indicates sampler placement for Run #2. Figures 2 and 3 shows the sampler placement for Runs #4 and 5 respectively. Runs #2, 4, and 5 were used for the sample analyses because they were considered to have the best representative samples. Runs #1 and 3 were not analyzed because of incomplete sampling or changes in wind direction during the sampling period. The laboratory results are included in Appendix A.

III. SAMPLING RESULTS

The sampling results for the chemicals and three metals are contained in Table I. The only samples in Table I which were above the detectable levels of the laboratory instruments were Cl, HCl, and low-volume lead.

The hi-volume samples were analyzed for lead, tin and zinc, and 28 other minerals which were not of interest to the MDNR. The levels are reported in Table II, and the complete laboratory results are in Appendix B.

TABLE II

HI-VOLUME RESULTS FOR LEAD, TIN, AND ZINC

		LEAD		TIN		ZINC	
Run	Flow (m^3)	Mass (ug)	Conc. (ug/m^3)	Mass (ug)	Conc. (ug/m^3)	Mass (ug)	Conc. (ug/m^3)
A-2	41.5	200	4.8	<30	0.7	88	2.1
B-2	34.7	20,700	596.5	<30	0.9	130	3.7
A-4	54.3	39,800	1,146.9	80	2.3	260	7.5
B-4	42.5	9,870	232.2	40	0.9	130	3.1
A-5	88.8	16,800	189.2	100	1.1	655	7.4
B-5	86.4	1,300	15.0	<30	0.3	120	1.4

The maximum pollutant concentration measured was for lead. The level of lead was calculated to be 1150 micrograms per cubic meter. Any emission of an airborne pollutant would be diluted by natural

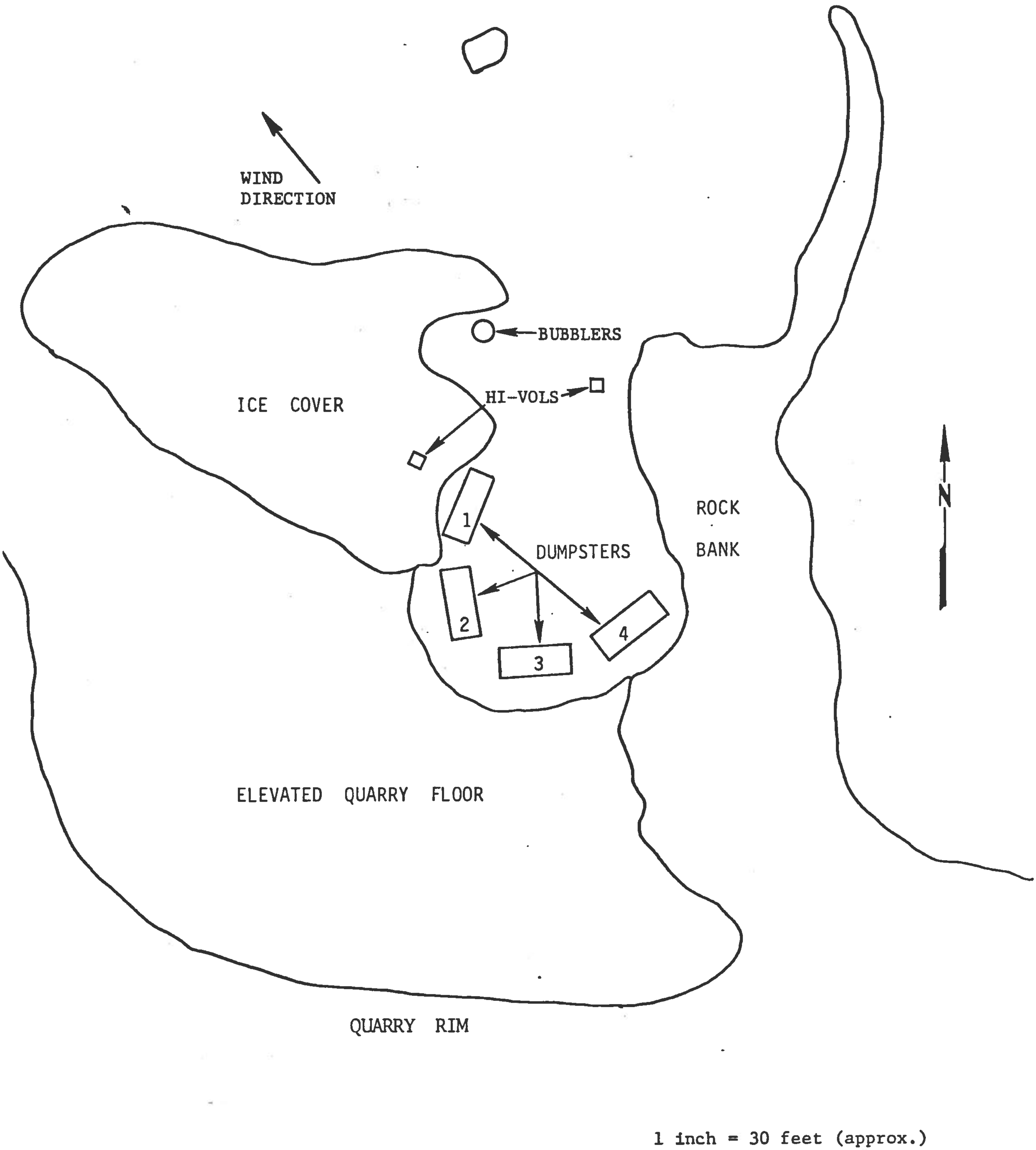


FIGURE 1: SAMPLER LOCATION RUN 2

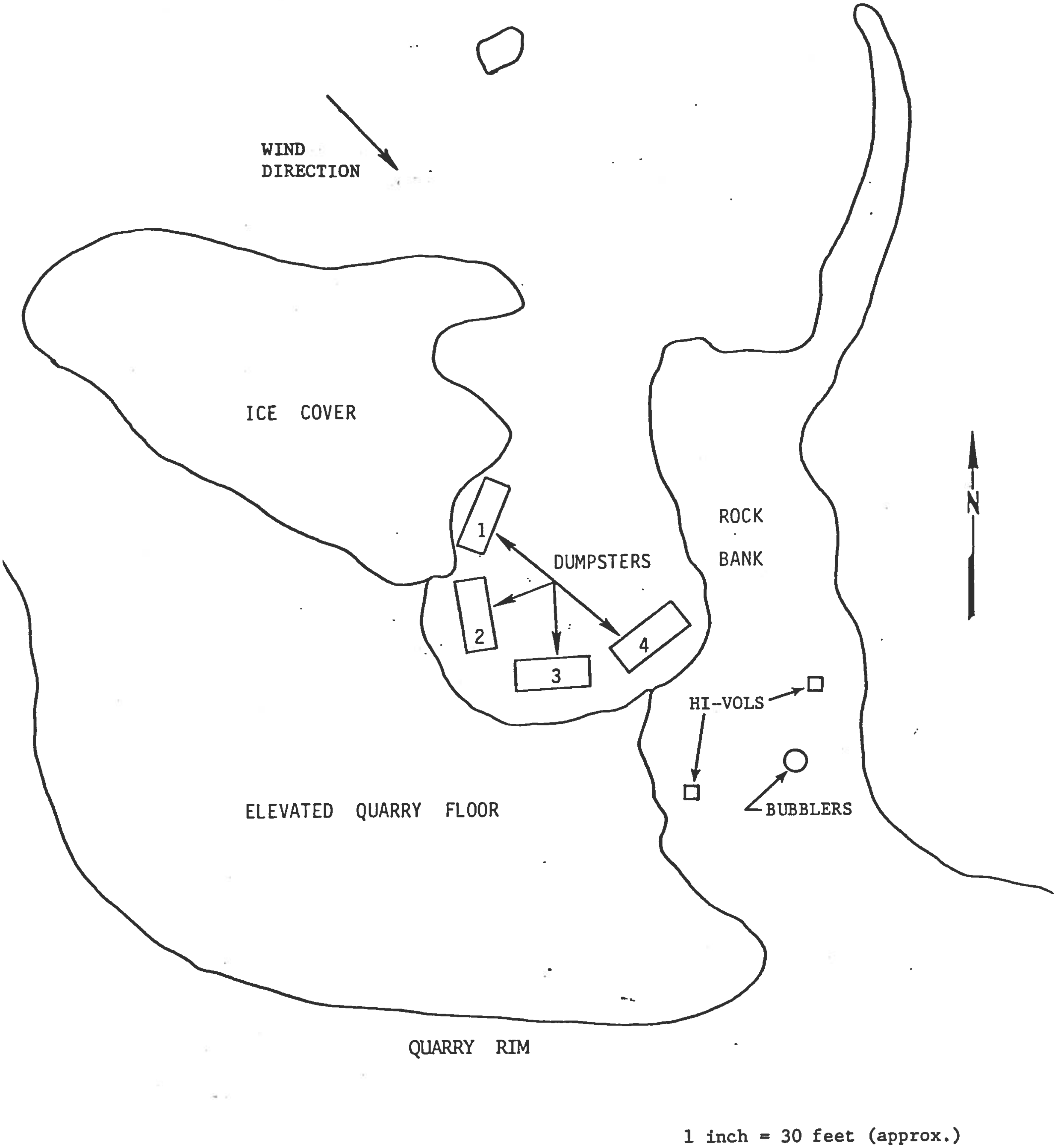
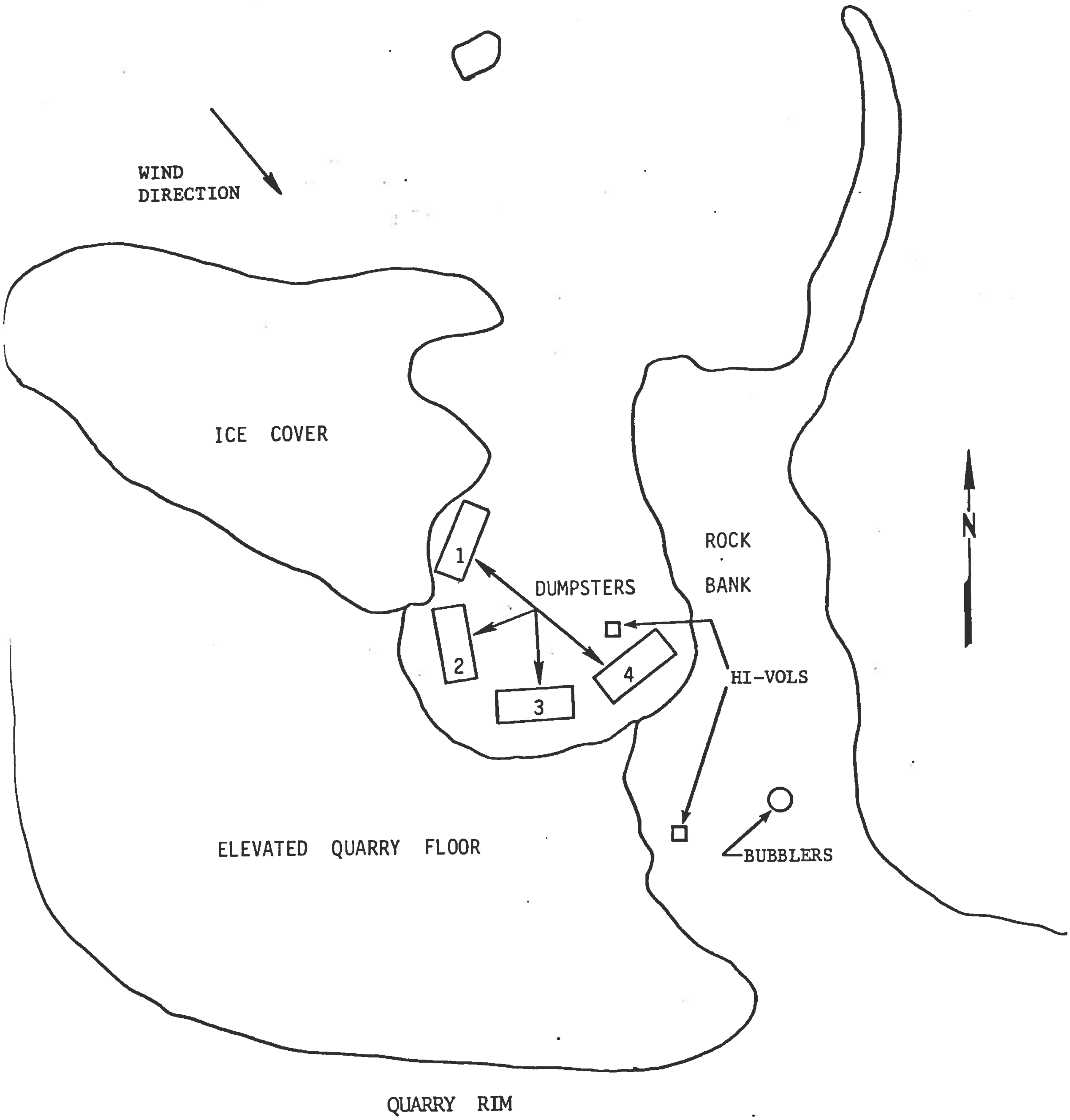


FIGURE 2: SAMPLER LOCATION RUN 4



1 inch = 30 feet (approx.)

FIGURE 3: SAMPLER LOCATION RUN 5

mixing. A conservative estimate was made to determine the concentration that might be experienced at the quarry rim using the USEPA PUFF model. These PUFF modelling runs were general estimates, but indicated at worse case conditions dillutions should still be around 500 to 1 or a maximum of 2.5 micrograms per cubic meter of lead at 100 meters from the source.

APPENDIX A

Ctek Laboratory Results

THE ENVIRONMENTAL HEALTH LABORATORY
of
Ctek
9742 SKILLMAN • DALLAS, TEXAS 75243 • 214/343-2025

LABORATORY REPORT 86/0005

86/01/31

SHELL ENGINEERING & ASSOC. INC
P.O. BOX 548
COLUMBIA MO 65205
ttn: CHRIS H. SCHREIBER, PE

EHL NO.	FIELD NO.	SAMPLE MEDIA	SAMPLE VOL.	ANALYSIS	RESULTS
G1362	#1 TRI & PENTA	IMP	15 ml	PHOSPHORUS PENTACHLORIDE	*
G1362	#1 TRI & PENTA	IMP	15 ml	PHOSPHORUS TRICHLORIDE	*
G1363	#2 TRI & PENTA	IMP	15 ml	PHOSPHORUS PENTACHLORIDE	<5.1 µg
G1363	#2 TRI & PENTA	IMP	15 ml	PHOSPHORUS TRICHLORIDE	<6.7 µg
G1364	#3 TRI & PENTA	IMP	15 ml	PHOSPHORUS PENTACHLORIDE	*
G1364	#3 TRI & PENTA	IMP	15 ml	PHOSPHORUS TRICHLORIDE	*
G1365	#4 TRI & PENTA	IMP	15 ml	PHOSPHORUS PENTACHLORIDE	<5.1 µg
G1365	#4 TRI & PENTA	IMP	15 ml	PHOSPHORUS TRICHLORIDE	<6.7 µg
G1366	#5 TRI & PENTA	IMP	15 ml	PHOSPHORUS PENTACHLORIDE	<5.1 µg
G1366	#5 TRI & PENTA	IMP	15 ml	PHOSPHORUS TRICHLORIDE	<6.7 µg
G1367	#1 PHOSGENE	IMP	15 ml	PHOSGENE	*
G1368	#2 PHOSGENE	IMP	15 ml	PHOSGENE	<0.1 µg
G1369	#3 PHOSGENE	IMP	15 ml	PHOSGENE	*
G1370	#4 PHOSGENE	IMP	15 ml	PHOSGENE	<0.1 µg
G1371	#5 PHOSGENE	IMP	15 ml	PHOSGENE	<0.1 µg
G1372	#1 CHLORINE	IMP	15 ml	CHLORINE	*
G1373	#2 CHLORINE	IMP	15 ml	CHLORINE	0.34 µg

THE ENVIRONMENTAL HEALTH LABORATORY
of
Ctek
9742 SKILLMAN • DALLAS, TEXAS 75243 • 214/343-2025

LABORATORY REPORT 86/0005

86/01/31

SHELL ENGINEERING & ASSOC. INC
P.O. BOX 548
COLUMBIA MO 65205
Attn: CHRIS H. SCHREIBER, PE

EHL NO.	FIELD NO.	SAMPLE MEDIA	SAMPLE VOL.	ANALYSIS	RESULTS
G1374	#3 CHLORINE	IMP	15 ml	CHLORINE	*
G1375	#4 CL2	IMP	15 ml	CHLORINE	0.23 µg
G1376	#5 CL2	IMP	15 ml	CHLORINE	0.66 µg
G1377	#2 SAMPLE SET	CEF	----	LEAD	<3.1 µg
G1377	#2 SAMPLE SET	CEF	----	TIN OXIDE	<11. µg
G1377	#2 SAMPLE SET	CEF	----	ZINC OXIDE	<1.2 µg
G1378	#3 SAMPLE	CEF	----	LEAD	*
G1378	#3 SAMPLE	CEF	----	TIN OXIDE	*
G1378	#3 SAMPLE	CEF	----	ZINC OXIDE	*
G1379	#4 TEST	CEF	----	LEAD	<3.1 µg
G1379	#4 TEST	CEF	----	TIN OXIDE	<11. µg
G1379	#4 TEST	CEF	----	ZINC OXIDE	< 1.2 µg
G1380	#5 LONG BURN	CEF	----	LEAD	12.0 µg
G1380	#5 LONG BURN	CEF	----	TIN OXIDE	<11. µg
G1380	#5 LONG BURN	CEF	----	ZINC OXIDE	< 1.2 µg
G1381	#1	OR22	----	HCL	*
G1381	#1	OR22	----	PHOSPHORIC ACID	*

THE ENVIRONMENTAL HEALTH LABORATORY
of
Ctek
9742 SKILLMAN • DALLAS, TEXAS 75243 • 214/343-2025

A.I.H.A. ACCREDITATION No.57

LABORATORY REPORT 86/0005

86/01/31

SHELL ENGINEERING & ASSOC. INC
P.O. BOX 548
COLUMBIA MO 65205
ttn: CHRIS H. SCHREIBER, PE

EHL NO.	FIELD NO.	SAMPLE MEDIA	SAMPLE VOL.	ANALYSIS	RESULTS
G1382	#2	OR22	----	HCL	23. µg
G1382	#2	OR22	----	PHOSPHORIC ACID	< 3. µg
G1383	#3	OR22	----	HCL	*
G1383	#3	OR22	----	PHOSPHORIC ACID	*
G1384	#4 UPSTREAM	OR22	----	HCL	30. µg
G1384	#4 UPSTREAM	OR22	----	PHOSPHORIC ACID	< 3. µg
G1385	#4 DOWNSTREAM	OR22	----	HCL	46. µg
G1385	#4 DOWNSTREAM	OR22	----	PHOSPHORIC ACID	< 3. µg
G1386	#5	OR22	----	HCL	35. µg
G1386	#5	OR22	----	PHOSPHORIC ACID	< 3. µg
G1387	#1	TGC	----	PHOSPHOROUS	*
G1388	#2	TGC	----	PHOSPHOROUS	<0.0015 µg
G1389	#3	TGC	----	PHOSPHOROUS	*
G1390	#4	TGC	----	PHOSPHOROUS	<0.0015 µg
G1391	#5	TGC	----	PHOSPHOROUS	<0.0015 µg

COMMENTS: * Not analyzed per your instructions.

THANK YOU !
Roger Hallstein
ROGER HALLSTEIN, Ph.D.
LABORATORY MANAGER

APPENDIX B

ETSRC "ICP" Results

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: SHELL ENGINEERING Units: MCG/FILTER
Batch #: B-86010220

Customer ID: A-2
ETSRC ID: 6010220

Elm	Result
AG	<6.
AL	2300.
AS	<60.
B	1100.
BA	58.
BE	<0.4
BI	<70.
CA	5960.
CD	19.
CO	<7.
CR	<20.
CU	79.
FE	130.
K	<1000.
LI	<5.
MG	2010.
MN	6.
MO	<8.
NA	28800.
NI	<20.
P	<200.
PB	200.
SB	<100.
SE	<70.
SI	1540.
SN	<30.
SR	38.
TI	4.
TL	<200.
V	<5.
ZN	88.

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
'roject: SHELL ENGINEERING Units: MCG/FILTER
Batch #: B-86010220

Customer ID: B-2
ETSRC ID: 6010221

:lm	Result
AG	<6.
AL	3920.
AS	<60.
B	1100.
BA	55.8
BE	<0.4
BI	<70.
CA	6120.
CD	300.
CO	<7.
CR	<20.
CU	190.
FE	562.
K	4200.
LI	<5.
MG	1870.
MN	7.9
MO	<8.
NA	29500.
NI	<20.
P	<200.
PB	20700.
SB	<100.
SE	<70.
SI	1310.
SN	<30.
SR	35.
TI	5.
TL	<200.
V	<5.
ZN	130.

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: SHELL ENGINEERING Units: MCG/FILTER
Batch #: B-86010220

Customer ID: A-4
ETSRC ID: 6010223

Elm	Result
AG	<6.
AL	3940.
AS	<60.
B	1200.
BA	75.6
BE	0.8
BI	<70.
CA	16500.
CD	200.
CO	<7.
CR	<20.
CU	380.
FE	1640.
K	1000.
LI	<5.
MG	3480.
MN	32.
MO	<8.
NA	27100.
NI	<20.
P	300.
PB	39800.
SB	2400.
SE	<70.
SI	5210.
SN	80.
SR	48.
TI	40.
TL	<200.
V	6.
ZN	260.

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: SHELL ENGINEERING Units: MCG/FILTER
Batch #: B-86010220

Customer ID: B-4
ETSRC ID: 6010224

Elm	Result
AG	<6.
AL	3120.
AS	<60.
B	1400.
BA	73.6
BE	<0.4
BI	<70.
CA	13100.
CD	44.
CO	<7.
CR	<20.
CU	140.
FE	549.
K	1000.
LI	<5.
MG	2790.
MN	13.
MO	<8.
NA	31800.
NI	<20.
P	<200.
PB	9870.
SB	660.
SE	<70.
SI	2620.
SN	40.
SR	47.
TI	15.
TL	<200.
V	<5.
ZN	130.

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: SHELL ENGINEERING Units: MCG/FILTER
Batch #: B-86010220

Customer ID: A-5
ETSRC ID: 6010225

Elm	Result
AG	10.
AL	13600.
AS	<60.
B	4200.
BA	300.
BE	<0.4
BI	<70.
CA	22300.
CD	2140.
CO	<7.
CR	<20.
CU	61.
FE	589.
K	7300.
LI	<5.
MG	7850.
MN	100.
MO	25.
NA	49700.
NI	<20.
P	<200.
PB	16800.
SB	530.
SE	<70.
SI	5920.
SN	100.
SR	179.
TI	52.
TL	<200.
V	<5.
ZN	655.

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: SHELL ENGINEERING Units: MCG/FILTER
Batch #: B-86010220

Customer ID: B-5
ETSRC ID: 6010226

Elm	Result
AG	<6.
AL	4280.
AS	<60.
B	1600.
BA	91. 1
BE	<0. 4
BI	<70.
CA	8520.
CD	230.
CO	<7.
CR	<20.
CU	17.
FE	170.
K	2000.
LI	<5.
MG	3100.
MN	17.
MO	<8.
NA	30200.
NI	<20.
P	<200.
PB	1300.
SB	<100.
SE	<70.
SI	1580.
SN	<30.
SR	58. 2
TI	8. 3
TL	<200.
V	<5.
ZN	120.

MCDONNELL AIRCRAFT COMPANY

GASES PRODUCED AS A RESULT OF REACTIVE WASTE (EXPLOSIVE) THERMAL TREATMENT

Proper Shipping Name	Hazard Class	New Explosive Weight (NEW) lbs	Explosive Compositions	Gases
Waste Actuating Cartridge, Explosive, Fire Extinguisher	Class C Explosive	0.0132	Polyvinyl Lead Azide Zirconium Potassium Perchlorate	K_2O - Potassium Oxide NO_x - Nitric Oxides $ZrCl_4$ - Zirconium Chloride
Waste Actuating Cartridge, Explosive Valve	Class C Explosive	0.0483	$BKNO_3$ - Boron Potassium Nitrate Smokeless Powder (Nitrocellulose)	B_2O_3 - Boric Anhydride CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water K_2O - Potassium Oxide N_2 - Nitrogen NO_x - Nitric Oxides
Waste Ammunition For Cannon With Empty Projectile	Class B Explosive	17.1200	Lead Azide Smokeless Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water NO_x - Nitric Oxides
Waste Ammunition For Cannon Without Projectile	Class B Explosive	1.6023	Ammonium Nitrate Black Powder RDX (cyclonite, hexogen, T4, cyclo-1,3,5,-trimethylene-2,4,6,-trinitramine; hexahydro-1,3,5,-trinitro-S-triazine). Smokeless Powder (Nitrocellulose) Zirconium Nickel Perchlorate	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2 - Hydrogen H_2O - Water H_2S - Hydrogen Sulfide N_2 - Nitrogen $NiCl_2$ - Nickel Chloride NO_x - Nitric Oxides $ZrCl_4$ - Zirconium Chloride

Encl (3) to
R.H. Kaatman ltr
dtd 28 Feb 86

MCDONNELL AIRCRAFT COMPANY

GASES PRODUCED AS A RESULT OF REACTIVE WASTE (EXPLOSIVE) THERMAL TREATMENT

Proper Shipping Name	Hazard Class	New Explosive Weight (NEW) lbs	Explosive Compositions	Gases
Waste Ammunition For Cannon with Solid Projectile	Class B Explosive	.4169	Lead Azide Smokeless Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water NO_x - Nitric Oxides
Waste Cartridge Cases, Empty, Primed	Class C Explosive	.0039	Lead Azide Smokeless Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water NO_x - Nitric Oxides
Waste Detonating Fuze, Class C Explosive	Class C Explosive	3.1560	DIPAM,- Dipicramide HNS, Type I & II - Hexanitrostilbene Lead Azide	CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water N_2 - Nitrogen NO_x - Nitric Oxides O_2 - Nitrogen
Waste Detonator, Class A Explosive	Class A Explosive	0.2309	Lead Azide HNS - Hexanitrostil-bene	CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water N_2 - Nitrogen NO_x - Nitric Oxides O_2 - Oxygen
Waste Detonator, Class C Explosive	Class C Explosive	0.0041	HNS, Type I - Hex-anitrostilbene Lead Azide Lead Styphnate (Lead Trinitro-resorcinate)	CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water N_2 - Nitrogen NO_x - Nitric Oxides O_2 - Oxygen

MCDONNELL AIRCRAFT COMPANY

GASES PRODUCED AS A RESULT OF REACTIVE WASTE (EXPLOSIVE) THERMAL TREATMENT

Proper Shipping Name	Hazard Class	New Explosive Weight (NEW) lbs	Explosive Compositions	Gases
Waste Drugs, NOS (Hexanitrostilbene)	Flammable Solid	0.2265	HNS - Hexanitrostilbene	CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water N_2 - Nitrogen O_2 - Oxygen
Waste Electric Squib	Class C Explosive	0.0229	Titanium Hydride Viton B (fluoroel-astomers any elasto-meric high polymer containing fluorine) Zirconium Potassium Perchlorate	KCl - Potassium Chloride K_2O - Potassium Oxide $TiCl_4$ - Titanium Te-trachloride TiF_4 - Titanium Te-trafluoride TiO_2 - Titanium Dioxide $ZrCl_4$ - Zirconium Chloride
Waste Explosive Cable Cutter	Class C Explosive	.0494	Barium Nitrate/Lead Styphnate Lead Azide Smokeless Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water NO_x - Nitric Oxides
Waste Explosive Power Device, Class B	Class B Explosive	75.3700	Ammonium Perchlorate, $BKNO_3$ - Boron Potas-sium Nitrate Carboxy - Terminated Polybutadiene Glycerol Triacetate Lead Nitrate 2-Nitro Diphenylamine Nitroglycerine Potassium Nitrate Potassium Perchlorate Smokeless Powder (Nitrocellulose)	B_2O_3 - Boric Anhydride CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2 - Hydrogen H_2O - Water HCl - Hydrogen Chloride K_2O - Potassium Oxide KCl - Potassium Chloride N_2 - Nitrogen NO_x - Nitric Oxides

MCDONNELL AIRCRAFT COMPANY

GASES PRODUCED AS A RESULT OF REACTIVE WASTE (EXPLOSIVE) THERMAL TREATMENT

Proper Shipping Name	Hazard Class	New Explosive Weight (NEW) lbs	Explosive Compositions	Gases
Waste Explosive Power Device, Class C	Class C Explosive	3.0870	Ammonium Perchlorate, Ammonium Nitrate (Amoco Lft - 6) $BKNO_3$ - Boron Potassium Nitrate RDX (cyclonite, hexogen, T4, cyclo-1,3,5, -trimethylene-2,4,6, -trinitramine; hexahydro-1,3,5,-trinitro-S-triazine). Smokeless Powder (Nitrocellulose) Zirconium Nickel Perchlorate	B_2O_3 - Boric Anhydride CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2 - Hydrogen H_2O - Water K_2O - Potassium Oxide N_2 - Nitrogen NH_4Cl - Ammonium Chloride $NiCl_2$ - Nickel Chloride NO_x - Nitric Oxides $ZrCl_4$ - Zirconium Tetrachloride
Waste Explosive Release Device	Class C Explosive	0.5628	HNS II A - Hexanitrostilbene Lead Azide Lead Styphnate (Lead Trinitroresorcinate) Molybdenum	CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water MoO_2 - Molybdenum Oxide N_2 - Nitrogen NO_x - Nitric Oxides O_2 - Oxygen
Waste Explosive Rivets	Class C Explosive	0.0008	Lead Azide Smokeless Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water NO_x - Nitric Oxides

MCDONNELL AIRCRAFT COMPANY

GASES PRODUCED AS A RESULT OF REACTIVE WASTE (EXPLOSIVE) THERMAL TREATMENT

Proper Shipping Name	Hazard Class	New Explosive Weight (NEW) lbs	Explosive Compositions	Gases
Waste Fuse, Mild, Detonating, Metal Clad	Class C Explosive	1.3069	DIPAM - Dipicramide HNS , Type I - Hex-anitrostilbene	CO - Carbon Monoxide CO_2 - Carbon Dixoide H_2O - Water N_2 - Nitrogen O_2 - Oxygen
Waste Fuze, Tracer	Class C Explosive	.0043	Magnesium Barium Peroxide	MgO - Magnesium Oxide BaO - Barium Oxide
Waste Hand Signal Device	Class C Explosive	3.4137	Dye Hexachlorobenzene Magnesium Powder Potassium Bicarbonate Potassium Perchlorate Strontium Nitrate Sugar	CO_2 - Carbon Dioxide Dye HCl - Hydrogen Chloride H_2O - Water KCl - Potassium Chloride MgO - Magnesium Oxide NO_x - Nitric Oxides SrO - Strontium Oxide
Hazardous Waste, Solid, NOS	ORM-E	.0082	DIPAM - Dipicramide HNS - Hexanitrostilbene Zinconium Potassium Perchlorate Viton B (fluoroelastomer any elastomeric high polymer containing fluorine)	CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water K_2O - Potassium Oxide N_2 - Nitrogen O_2 - Oxygen $ZrCl_4$ - Zirconium Chloride ZrF_4 - Zirconium Tetrafluoride

MCDONNELL AIRCRAFT COMPANY

GASES PRODUCED AS A RESULT OF REACTIVE WASTE (EXPLOSIVE) THERMAL TREATMENT

Proper Shipping Name	Hazard Class	New Explosive Weight (NEW) lbs	Explosive Compositions	Gases
Waste High Explosive	Class A Explosive	11.9800	HNS - Hexanitrostilbene PETN (nitropentaerythrite, pentaerythrite tetranitrate, pentaerythritol tetranitrate). RDX (cyclonite, hexogen, T4, cyclo-1,3,5,-trimethylene-2,4,6,-trinitramine; hexahydro-1,3,5,-trinitro-S-triazine). Smokeless Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2 - Hydrogen H_2O - Water N_2 - Nitrogen NO_x - Nitric Oxides O_2 - Oxygen
Waste Igniter	Class C Explosive	0.0059	$BKNO_3$ - Boron Potassium Nitrate RDX (Cyclonite, hexogen, T4, cyclo-1,3,5,-trimethylene-2,4,6,-trinitramine; hexahydro-1,3,5,-trinitro-S-triazine)	B_2O_3 - Boric Anhydride CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2 - Hydrogen H_2O - Water K_2O - Potassium Oxide N_2 - Nitrogen NO_x - Nitric Oxides
Waste Jet Thrust Unit	Class B Explosive	1.0700	Ammonium Perchlorate $BKNO_3$ (Boron Potassium Nitrate) Carboxy - Terminated Polybutadiene Glycerol Triacetate Lead Nitrate 2-Nitro Diphenylamine Nitroglycerine Potassium Nitrate Potassium Perchlorate Smokeless Powder (Nitrocellulose)	B_2O_3 - Boric Anhydride CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2 - Hydrogen H_2O - Water HCl - Hydrogen Chloride K_2O - Potassium Oxide KCl - Potassium Chloride N_2 - Nitrogen NO_x - Nitric Oxides

MCDONNELL AIRCRAFT COMPANY

GASES PRODUCED AS A RESULT OF REACTIVE WASTE (EXPLOSIVE) THERMAL TREATMENT

Proper Shipping Name	Hazard Class	New Explosive Weight (NEW) lbs	Explosive Compositions	Gases
Waste Propellant Explosive (Solid), Class B	Class B Explosive	0.3259	$BKNO_3$-Boron Potassium Nitrate	B_2O_3 - Boric Anhydride K_2O - Potassium Oxide N_2 - Nitrogen NO_x - Nitric Oxides
Waste Propellant Explosive, In Water	Class B Explosive	9.1050	Black Powder (Blasting Powder - Composing of Potassium Nitrate, Charcoal and Sulfur) Smokeless Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water NO_x - Nitric Oxides SO_x - Sulfur Oxides
Waste Pyroforic Liquid, NOS	Flammable Liquid	0.2200 (Not NEW)	Trimethyl Aluminum	Al_2O_3 - Aluminum Oxide - very small amount in smoke as powder CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water
Waste Rocket Motor	Class B Explosive	82.6400	Ammonium Perchlorate, $BKNO_3$-Boron Potassium Nitrate Carboxy - Terminated Polybutadiene Glycerol Triacetate Lead Nitrate 2-Nitro Diphenylamine Nitroglycerine Potassium Nitrate Potassium Perchlorate Smokeless Powder (Nitrocellulose)	B_2O_3 - Boric Anhydride CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2 - Hydrogen H_2O - Water HCl - Hydrogen Chloride K_2O - Potassium Oxide KCl - Potassium Chlorid N_2 - Nitrogen NO_x - Nitric Oxides

MCDONNELL AIRCRAFT COMPANY

GASES PRODUCED AS A RESULT OF REACTIVE WASTE (EXPLOSIVE) THERMAL TREATMENT

Proper Shipping Name	Hazard Class	New Explosive Weight (NEW) lbs	Explosive Compositions	Gases
Waste Small Arms Ammunition	Class C Explosive	734.9150	Lead Azide Smokelsss Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water NO_x - Nitric Oxides
Waste Small Arms Primer	Class C Explosive	0.1007	Lead Azide Smokeless Powder (Nitrocellulose)	CH_3OH - Methyl Alcohol CO - Carbon Monoxide CO_2 - Carbon Dioxide H_2O - Water NO_x - Nitric Oxides
Waste Torpedo, Railway	Class B Explosive	0.0531	Black Powder Potassium Chlorate Potassium Perchlorate Sulfur	ClO_x - Chlorine Oxides KCl - Potassium Chloric K_2O - Potassium Oxide NO_x - Nitric Oxides SO_x - Sulfur Oxides
	Total NEW	946.8437		
	Total Weight Pyroforic Liquid, NOS	.2200		
	Grand Total	947.0637		